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MODIS Reflective Solar Bands Calibration Algorithm and On-orbit Performance

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ABSTRACT

The MODerate Resolution Imaging Spectroradiometer (MODIS) is one of the key instruments for the NASA's Earth Observing System (EOS). The MODIS ProtoFlight Model (PFM) was launched on-board the EOS Terra spacecraft on December 18, 1999 and has been providing the science community and public users global data sets for the study of the land, oceans, and atmosphere for more than two and a half years. This coverage is further enhanced by the data sets from the MODIS Flight Model (FM-1) that was launched on-board the EOS Aqua spacecraft on May 4, 2002. MODIS has 36 spectral bands with wavelengths ranging from 0.41 to 14.5 μ m and nadir spatial resolutions of 250m (2 bands), 500m (5 bands), and 1km (29 bands). The sensor's 20 reflective solar bands (RSB) from 0.41 to 2.1 μ m are calibrated on-orbit by a solar diffuser (SD) and a solar diffuser stability monitor (SDSM) system. The other 16 thermal emissive bands (TEB) with wavelengths above 3.7 μ m are calibrated by a blackbody. This paper describes the RSB on-orbit calibration approach using the SD/SDSM system, its implementation in the Level 1B algorithm, and the RSB on-orbit characterization and performance for both Terra and Aqua MODIS. The TEB calibration algorithm and performance are presented in a separate paper in these proceedings.

Keywords: Terra, Aqua, MODIS, calibration, solar diffuser, solar diffuser stability monitor

1. INTRODUCTION

The Earth Observing System spacecraft EOS/Terra and EOS/Aqua, launched on December 18, 1999 and May 4, 2002 respectively, view Earth from sun-synchronous polar orbits at an altitude of 705km. The equator crossing time of the Terra spacecraft is 10:30 AM (local time, descending node) and that of the Aqua spacecraft is 1:30 PM (local time, ascending node). The MODerate Resolution Imaging Spectroradiometer (MODIS) ProtoFlight Model (PFM) is on-board the Terra spacecraft and the Flight Model (FM-1) is on-board the Aqua spacecraft. Both instruments have been providing global data sets for the study of the land, oceans, and atmosphere with morning and afternoon observations¹⁻². MODIS has 36 spectral bands with wavelengths ranging from 0.41 to 14.5 μ m and nadir spatial resolutions of 250m (2 bands), 500m (5 bands), and 1km (29 bands). MODIS heritage sensors include the Advanced Very High Resolution Radiometer (AVHRR), the Coastal Zone Color Scanner (CZCS), the Sea-viewing Wide Field of View Sensor (SeaWiFS), and the High Resolution Infrared Radiation Sounder (HIRS)³⁻⁴. Its design and technology development have been served as the pathfinder for the next generation sensors, such as the Visible/Infrared Imaging Radiometer Suite (VIIRS) in the National Polar-Orbiting Operational Environment Satellite System (NPOESS)⁵.

The MODIS 20 reflective solar bands (RSB) cover the wavelengths from 0.41 to 2.1 μ m. These bands are calibrated on-orbit by a solar diffuser (SD) and a solar diffuser stability monitor (SDSM) system. In this paper we focus on the RSB on-orbit calibration methodology and its implementation in the Level 1B algorithm. We also show the on-orbit calibration results and the instrument performance for the RSB in both Terra and Aqua MODIS. The other 16 thermal emissive bands (TEB) with wavelengths above 3.7 μ m are calibrated by an on-board blackbody. The algorithm description and on-orbit performance for the TEB are presented by Xiong *et. al.* in a separate paper in these proceedings⁶.